Validation of SMAP L2 passive-only soil moisture products using upscaled in situ measurements collected in Twente, The Netherlands

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Abstract

The Twente region in the east of the Netherlands has a network with 20 soil monitoring stations that has been utilized for validation of the Soil Moisture Active/Passive (SMAP) passive-only soil moisture products. Over the period from April 2015 until December 2018, seven stations covered by the SMAP reference pixels have fairly complete data records. Spatially distributed soil moisture simulations with the Dutch National Hydrological Model have been utilized for the development of upscaling functions to translate the spatial mean of point measurements to the domain of the SMAP reference pixels. The native and upscaled spatial soil moisture means computed using the in situ measurements have been adopted as references to assess the performance of the SMAP (i) Single Channel Algorithm at Horizontal Polarization (SCA-H), (ii) Single Channel Algorithm at Vertical Polarization (SCA-V), and (iii) Dual Channel Algorithm (DCA) soil moisture estimates. In the case of the Twente network it was found that the SCA-V SMAP soil moisture observations collected in the afternoon had the best agreement with the native spatial mean, leading to an unbiased root mean squared error (uRMSE) of 0.059 $m^3 m^{-3}$, whereas for the upscaled in situ references primarily larger biases were found. These error levels are larger than the mission's target accuracy of 0.04 $m^3 m^{-3}$, which can be attributed to large over- and under-estimation errors (>0.08 $m^3 m^{-3}$), in particular at the end of dry spells and during freezing, respectively. The strong vertical dielectric gradients associated with rapid soil freezing and wetting cause the disparity in soil depth characterized by SMAP and in situ that leads to the large mismatches. Once filtered for frozen conditions and antecedent rainfall, the uRMSE improves to 0.043 $m^3 m^{-3}$.

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